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THREE SCHEMES *for* CONVEYING INTELLIGENCE
to GREAT DISTANCES *by* SIGNALS. By JOHN
COOKE, *Esq; M. R. I. A.*

THE great expedition with which the French Telegraph transmits dispatches has excited a considerable degree of public attention; its use in war is manifest, and 'tis probable that it may be applied to commercial purposes with equal success. While the knowledge of this invention remains confined to any nation it must be attended with advantages inconsistent with the interests of other countries, and therefore an attempt to discover the principles of it, or to supply new methods of effecting the same end, is capable of consequences beyond the mere gratification of curiosity.

Read Dec.
6, 1794.

THE first step necessary in the following plans is to express words by the smallest possible number of characters; for this purpose let the correspondents be furnished with similar alphabetical

betical vocabularies of our language, omitting synonymous terms, and such as are not absolutely necessary ; they should contain the proper names of men that generally occur, the names of contiguous and important places, and an appendix of such phrases and sentences as the correspondents may expect to have occasion for ; to the words of these vocabularies are to be annexed in marginal columns the single letters, and the different combinations which arise by joining any two, or any three letters of the alphabet together, so that every word and sentence in the vocabulary may have a sign to represent it, consisting of one, two or three letters at the most ; the variety of combinations thus produced by twenty-four letters (each combination consisting of two or three letters only) far exceeds the number of useful words, and affords signs sufficient for a very copious addition of sentences.

WHEN intelligence is to be conveyed, the list of sentences annexed to the vocabulary should be examined for one adapted to the occasion, and if any of them apply, the symbolical letters annexed thereto will denote it ; but if there be no such sentence in the collection, the matter is to be put into the fewest words which perspicuity will allow, and the symbols which represent these words are to be substituted for them ; thus the sentence may be expressed by a set of letters which seldom amount to half the number necessary to spell the words of it. When
proper

proper names occur which are not found in the vocabulary, or which cannot be formed out of any words in it, they must be expressed by their constituent letters, and admit of no abridgement. If secrecy be required, any preconcerted alteration of the arrangement of the words in the vocabulary will render the signs unintelligible to all except these who may be in possession of the key.

AFTER a sentence shall be reduced into symbols or signs, the next consideration is to convey them expeditiously to a great distance by a simple and certain method. Light seems to be the most proper instrument for this purpose, and may be applied in the following manner :

LET the space through which the intelligence is to be transmitted be divided into stations, and at each of them let three lights be placed at considerable distances from each other, so as to be distinguishable from the two next posts or stations : let there be a method provided of obscuring any of them at pleasure.

AT each station there is to be a person appointed to look out for signals at a certain hour ; the signal requiring attention may be the exhibition of the three lights, and the same may be also the signal of readiness to receive the communication : these three lights are intended to represent the three places of the symbolical letters

letters of the vocabulary, and their obscurations denote the letters which occupy these places; thus one obscuration signifies *A*, two *B*, three *C*, &c.

SUPPOSE it were required to communicate the word “ victory,” the three lights are to be exhibited from the first station; and when the same appearance is seen from the next station, the vocabulary is to be searched for the sign of that word, which we will suppose to be *K B A*; then the first light is to be obscured ten times, the second light twice, the third once, and then all may be concealed together to show that the word is complete. These signals should be observed by two persons at least from the next station, and if the result of their observations should vary and occasion doubt, the second station may exhibit two lights only, which signal requires a repetition of the last word; but if there be no disagreement among the observers, the second station proceeds to transmit the same signals which it received to the third station; and in the same manner they are communicated through all the intermediate posts, until they arrive at the end of the line, where the observer examines the signs or symbols in his vocabulary for the letters *K B A*, (which may be easily found if arranged in alphabetical order) and there finds the word “ victory” annexed to it. When the communications are to be forwarded by day, flags or any other object visible by day may be used, and their elevations and depressions may be substituted

Fig. 2.

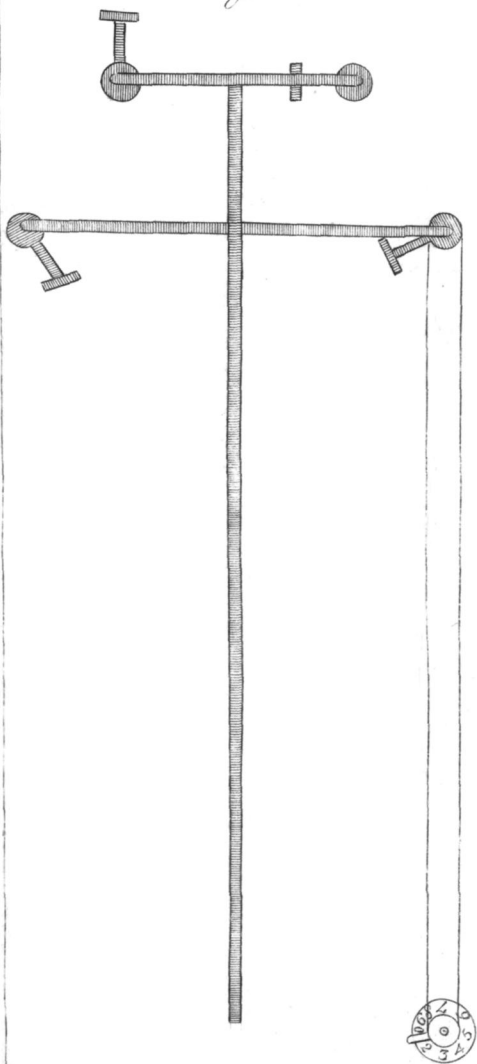


Fig. 3

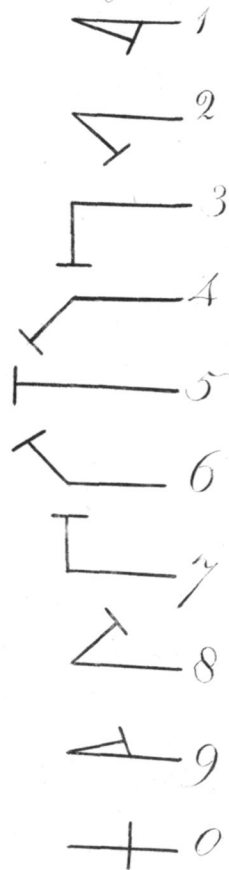
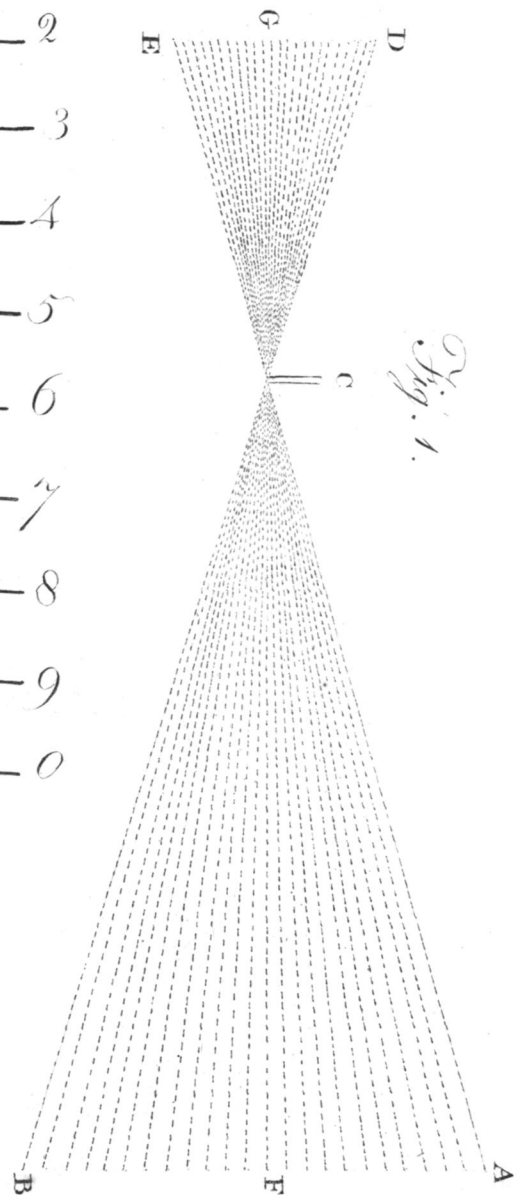


Fig. 1.



substituted for the exhibitions and occultations of the lights; even a single light or flag may be made to answer the purpose, if any contrivance be annexed to signify to the observer when the occultations which denote a letter are ended, and also when a word is finished.

ANOTHER method of transferring these signals is by altering the situations of these lights or flags, the plan of which will be better understood by a diagram than by any general description.

THE point *F*. fig. 1. represents the place from which the intelligence is to be sent, and the point *G* that to which it is to be conveyed. In the horizontal line *AB*, 24 points are assumed at equal intervals to represent the letters of the alphabet, and marked as in the figure. When it is intended to signify a sentence or a word, lights by night, or flags by day, are to be set up in the points of the line which represent the symbolical letters that denote it, and the true position of these lights or flags may be thus ascertained at the point *G*. Let there be a pole erected at a convenient distance from *G* in the line *GF*, as at *C*, and a line *DE* parallel to *AB* be graduated as *AB*, and marked as in the figure with the 24 letters, the observer at *G* moves his eye along the line *DE* until the edge of the pole *C* is seen in the same line with the light exhibited in the line *AB* and the position of his eye in the line *DE* marks the letter

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signified

signified by the signal in the line AB : and thus by three lights by night, or three flags by day, may the symbolical characters of a word or sentence be communicated. However it must be observed, that though the letters be thus represented, their places as they are written in the symbol do not appear, therefore it will be necessary that after the signals shall have been sufficiently observed, they should be removed in the order in which they are to be written, so that the signal which represents the letter at the left hand in the symbol should be first removed, that of the middle letter is next to be removed, and the signal of the right hand letter is to be removed last: or their order may be denoted by the shape or colour of the flags or lights. Since the triangles ABC , CDE are similar, the sides $AC:AB::EC:ED$. whence it follows, that if the distance AC be ten miles, the line AB 240 yards, and the distance EC a quarter of a mile, that the line DE will be six yards, and the graduations on it nine inches asunder, a space sufficient to prevent confusion or mistake in ascertaining the place of the signals fixed in the line AB , or if at the point where the observer is placed, a telescope be fixed, with a micrometer annexed, it will be possible to ascertain the places of the signals with a great degree of nicety, and two lights in that case will be sufficient to designate a word or sentence.

In order to effect this an alteration must be made in the vocabulary, by changing the symbols of the words, from letters
to

to numbers, beginning with unity and proceeding in regular order to the extent required, which 'tis supposed will not exceed ten thousand. Then if the line in which the signals are to be placed be 255 yards 7 inches long, it may be divided into one hundred parts of 7 feet 8 inches each, the extremities of which parts should be numbered, and if there be two lights or two flags distinguishable by their shape, or by their colour, or by both, one may represent units, and the other hundreds, by which any number under ten thousand, and of course any word or sentence in the vocabulary can be expressed: for instance, if the number of the word to be communicated be 5796, the flag or light which represents hundreds is to be placed in the graduation of the line of signals marked 57, which signifies fifty-seven hundred, and the signal which represents units is to be placed in the graduation marked 96, which denotes the number ninety-six, the sum of which is the symbolical number proposed.

IN order to observe these signals and their places, Mr. Cavallo's instrument (described in the Philosophical Transactions of the year 1791) seems to be well adapted; it is a micrometer of a very simple kind, applied to a three feet achromatic telescope, which magnifies about eighty-four times, and with which he could measure an angle of 7 seconds accurately; the scale of it may be so marked that the numbers represented by the signals may be seen at the time of observation without calculation or moving any of its parts.

MR. CAVALLO shows in the same paper that an angle of one minute includes a chord of six feet at 20626 feet distance; whence it follows from the nature of similar triangles, that at the distance of 52800 feet or ten miles, the chord of the same angle will be $15\frac{1}{3}$ feet nearly, and 7 feet 8 inches, the length of the divisions of the signal line, will be seen under an angle of half a minute nearly, at ten miles distance, which may be taken with great certainty, since the instrument is capable of measuring a fourth part of this angle; another cause which must contribute materially to the exactitude of the observation is, that both the telescope and micrometer are to remain permanently fixed, as well in their direction as in the relative position of all their parts, and if the scale of the micrometer be graduated by the signals of the next station, nothing but some disturbance of the machinery can occasion error, since the same immoveable mark on the scale is always referred to the same immoveable object.

It is evident, from the preceding method, that any sort of signals capable of communicating all the numbers under ten thousand will enable the correspondents to denote words and sentences thereby, and it seems possible to accomplish this by an instrument something like what we conceive the telegraph to be, as represented in the drawing, fig. 2. It is an upright pole with two immoveable transverse arms, *CD* and *EF*, at the extremities

mities of which are placed hands capable of being moved round
 on their extremities by pullies and ropes; each of these hands
 is capable of ten different positions, which are sufficiently dis-
 tinguishable from each other, as may be seen in fig. 3, and
 which may represent the ten cyphers, and if we suppose the hand
 at *E* to represent units, that at *C* to represent tens, that at *D* to
 represent hundreds; and that at *F* thousands, it is plain that the
 number of any word under ten thousand may be denoted, by a
 single arrangement of the parts of the instrument, and that
 these may be observed at a great distance by a telescope: for in-
 stance, if it were required to represent the number 2701, the
 hand at *E* is to be put into the second position, that at *D* into the
 seventh, *C* into the tenth, and *E* into the first position. If it
 were necessary to represent a word the number of which was 26,
 the hands at *F* and at *D* are to be put into the tenth position, to
 signify no thousands no hundreds, that at *C* into the second, and
 that at *E* into the sixth position. In order to work this instru-
 ment, there may be a pulley affixed to the end of each hand, and
 a rope, the ends of which are to be joined together, is to pass
 over it, and also to pass over another pulley of equal diameter at
 the bottom, so that the hand may be moved by moving the
 pulley below; let the lower pulley be furnished with an index,
 and let the numbers, which it may be required to represent by the
 hand above, be written on a fixed circle round the lower pulley
 so that the index may be turned to any of them, and fastened
 there;

there; then the hand may be brought into the position required, by placing the index below on the number to be represented; and thus any person, though not acquainted with the signals, can work the machine without danger of error, and signify the numbers with almost as much dispatch as they could be written. The form of one of these pullies with the ropes for working the hand is seen in the drawing at *A*, and the three remaining hands are understood to be furnished with similar machinery.

It may be useful to observe that it is not necessary that the correspondents should understand any common language, for if they be furnished with vocabularies in their own respective tongues, and if the same symbols be referred in each to a word of equal import, every correspondent will understand it through the medium of his own tongue, and the symbols will answer the purpose of an universal language for these, and also for other communications.